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WATERTOWN ARSENAL LABORATORY

MEMORANDUM REPORT

NO. WAL 710/672

Comparative Resistance of Light-Gauge (.045") X4130 Steel and 8630 Steel, As-Rolled and After Heat Treatment, to Perforation by Flak-Simulating Projectiles

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BY

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Eighteenth Partial Report on Problem B-6.2

18 September 1944

Comparative Resistance of Light-Gauge (.045") X4130 Steel and 8630 Steel, As-Rolled and After Heat Treatment, to Perforation by Flak-Simulating Projectiles

1. In response to a request of the Office, Chief of Ordnance[1], tests have recently been conducted at this arsenal on samples of light-gauge (about .045") SAE-X4130 steel and NE-8630 steel as-rolled and after heat treatment.

2. Heat treatment effected a substantial improvement in the resistance characteristics of both types of steel, although the resistance of an equivalent weight of Hadfield manganese steel is still superior to that of the heat-treated samples. Because of the difference in actual thickness of the samples no authoritative estimate of the relative merits of the two types could be made.

3. Duplicate samples of X4130 steel and of 8630 steel were received, as rolled, from the Carnegie-Illinois Steel Corporation through the offices of the Materiel Command, Army Air Forces. One sample of each was subjected to fire with cal. .45 steel-jacketed ball projectile. The other sample of each was given the following heat treatment:

1600°F - 10 minutes - oil

300°F - 1 hour - air

after which it was subjected to fire both with cal. .45 ball projectiles and with cal. .22 flak-simulating projectiles, G-2[2]. The results appear in Table I.

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1. O.O. 470.1/39766 - Wtn 470.1/7415, dated 10 May 1944.

2. Watertown Arsenal Laboratory Memorandum Report No. WAL 762/253, "Development of a Projectile, to Be Used in Testing Body Armor, to Simulate Fragments of a 20 mm. H.E. Projectile" 7 January 1944.

4. The resistance of both steels to perforation by cal. .45 steel-jacketed ball projectiles was considerably enhanced by heat treatment. Although even this improved resistance does not equal that of Hadfield manganese steel of equivalent weight, it is encouraging to note that compared with other ferritic steels in this gauge range, both steels after the given heat treatment, exhibited extremely good resistance characteristics. It is felt that such steels, heat treated properly, will afford excellent resistance to perforation in heavier gauges (about .090") and on a comparative basis will afford resistance superior to Hadfield manganese steel of equivalent weight.

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APPROVED:

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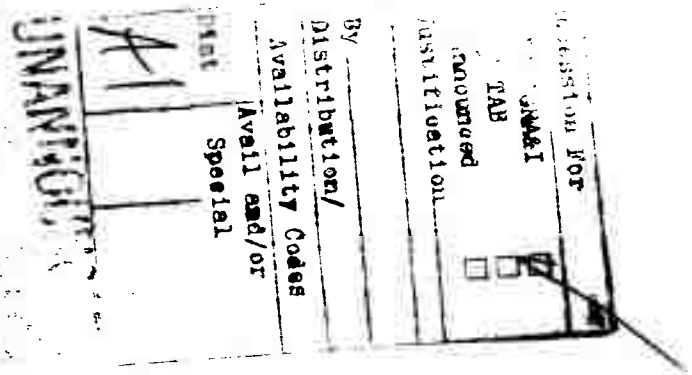
TABLE I

Summary of Results of Tests Conducted at Watertown Arsenal on Samples of X4130 Steel and 8630 Steel

Sample No.	Condition	Chemical Composition C	Mn	P	S	Si	Ni	Cr	Mo	Actual Gauge	Hardness (Rockwell "C")	Ballistic Limit (F/S) Cal. .45[1]	G-22[2]
C9-1	Heat Treated	.29	.47	.017	.025	.28	—	.98	.20	.048"	51	917	1683
C9-2	As Rolled	.29	.47	.017	.025	.28	—	.98	.20	.048"	22	616	—
C10-1	Heat Treated	.29	.73	.018	.028	.25	.46	.52	.17	.042"	49	880	1390
C10-2	As Rolled	.29	.73	.018	.028	.25	.46	.52	.17	.043"	24	378	—
For Comparison:													
Average Hadfield Manganese Steel										.042"	—	920	1630
										.048"	—	980	1720

[1] Cal. .45 steel-jacketed ball projectile - 230 grains.
[2] Cal. .22 fragment-simulating projectile - 17 grains.



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ABSTRACT:

Tests were made on samplss of light-gauge (.045") SAE-X4130 steel and NE-8830 steel as-rolled and after heat treatment to determine comparative reslstance to perforation by flak-simulating projectiles. One sample of each was subjected to fire with cal. .45 steel-jacketed ball projectile. Ths other sample of each was given the following heat treatment: 1800°F for ten minutes, oil-quenched, and 300°F for 1 hour, air-quenched, after which lt was subjected to flre both with cal. .45 projectiles and cal. .22 flak-simulating projectiles, G-2[2]. The reslstance of both steels to perforation by cal. .45 projectiles was conslderably enhanced by heat treatment. Although sven this improved resistance does not equal that of Hadfield manganese steel of equivalent weight, both steels exhiblted extremely good reslstance character-lstics compared with other ferritic steels of this gauge. The steels tested when properly heat treated may afford excellsnt resistance to perforation in heavier gauges.

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